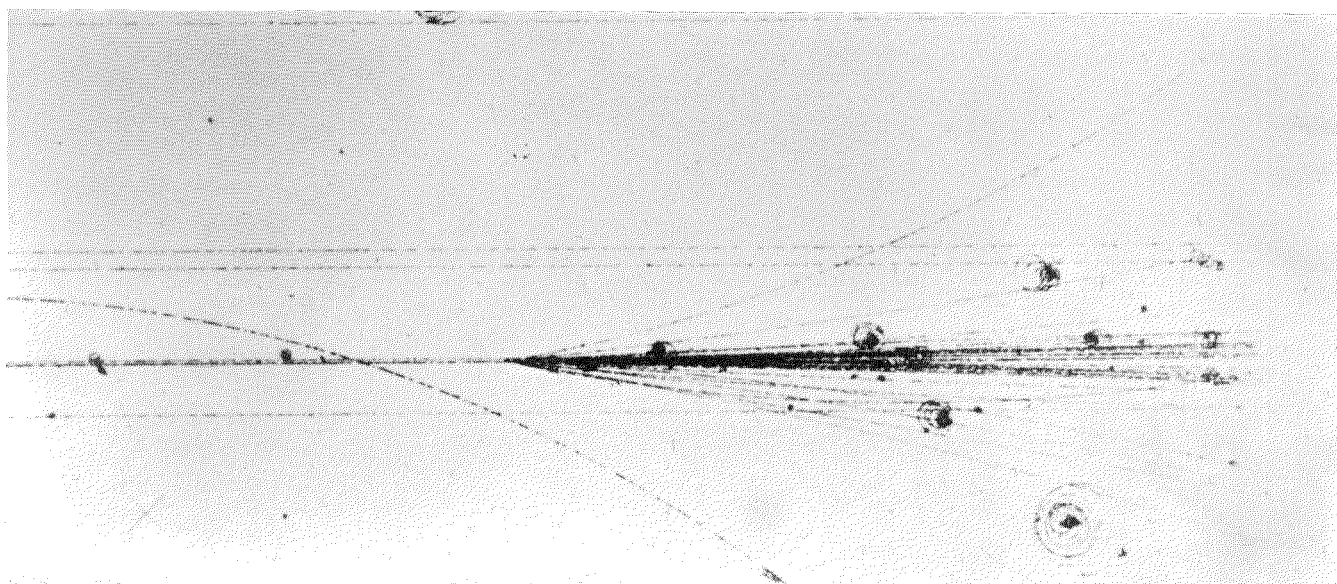




**MONTHLY REPORT OF ACTIVITIES**

August 31, 1972



**300-GeV PROTON INTERACTION IN THE 30-IN. BUBBLE CHAMBER**



THE COVER: A very high multiplicity event (26 prongs) produced by a 300-  
GeV proton in the 30-in. bubble chamber.

## MONTHLY REPORT OF ACTIVITIES

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Abstract: This report summarizes the activities of the National Accelerator Laboratory in August, 1972.

The highlight during this month was Experiment 37A in which 300-GeV protons were brought into the 30-in. bubble chamber. More than 16,000 pictures were taken using four 35-mm cameras. Throughout this run, pictures were also taken in the downstream wide-gap spark chambers for Experiment 2-I. Additionally, during a portion of the run, the upstream proportional chamber system (Experiment 154) was exercised successfully for tagging the positions of incoming beam particles at the bubble chamber.

Early in the month preliminary data from a proton beam interacting with the hydrogen jet were obtained. Difficulties with the PDP-11 have been resolved, and American and Russian detection apparatus were interfaced to the computer and hardware/software refinements were undertaken. Data from previous foil target runs have been analyzed using newly developed off-line software that permits very rapid data reduction.

A paper describing measurements of differential cross section for small-angle p-p scattering from 25 to 200 GeV incident proton energy and energy dependence of p-p total cross sections from 48 to 196 GeV incident proton energy is being submitted to the International High Energy Physics Conference being held at NAL in September.

During the first week of August, data were taken using the CH<sub>2</sub> foil target on the reaction  $p + p \rightarrow p + \text{Anything}$ , and a paper is being prepared for presentation at the International Conference at NAL next month.

Data were taken in the backward direction for a photon production experiment until the accelerator shutdown in early August. A paper based on preliminary analysis of the data is being prepared for presentation at the International High Energy Physics Conference. This paper describes the scaling hypothesis for photon production in nucleon-nucleon collisions over a continuous range of incident proton energies from 28 to 303 GeV. During the shutdown the experimental apparatus was shifted downstream in preparation for a run in the forward direction with the hydrogen jet.

#### Accelerator General

At the beginning of the month, there was stable 300-GeV operation for a week. The major part of August was taken up with a 10-day shutdown and with recovering from it.

The major work accomplished during the shutdown was the installation of a new booster control system. This system came into operation quite smoothly, with more hardware than software problems. However a large number of other minor problems occurred which individually and collectively prevented any useful operation throughout the rest of the month. By the end of the month, however, stable 200-GeV beam was again available, at least intermittantly.

#### Linac

During August a prebuncher (between the Cockcroft-Walton and linac) was tested. It not only raised the current captured and accelerated in the linac from 25 to 50 mA, but doubled the beam accelerated to 7 GeV in the booster.

Experiments were carried out at high intensity. At 80 mA, accelerated current (compared with the nominal design current of 67.5 mA), the transverse emittances were only slightly larger than at low current and were only 20% larger than the design emittance. The momentum spread was 50% larger than the design value (with debuncher), but there was no time to attempt to reduce it.

There is now 90% transmission of beam in the 200-MeV line, and it is believed that 100% transmission can be reached with more time.

### Booster

As noted earlier the new Sigma 3 control system was installed and made operational during the month. Also during the shutdown all the water-cooled blocking capacitors have been replaced by air-cooled ones, operating with forced ventilation. It is expected that at least six pulses may be injected from the booster when operating at 200 GeV. One of the past problems in the booster which has so far been unexplained is that a considerable number of rf bunches are lost during acceleration. The missing bunches in the booster are now thought to be the result of a head-tail effect. The sensitivity of the effect to sextupoles is corroborating evidence of this.

### Injection, Extraction, and Switchyard

During the shutdown, additional beam diagnostic equipment was added to the 8-GeV line. The second electrostatic-septum module was installed. Both modules are now remotely adjustable. Monitoring equipment was installed in the first 1500 feet of the external beam line. All magnets for the Proton Laboratory central line were installed and cabling should be finished within the next two weeks. The Meson Laboratory beam line was completed to the target. The Proton Laboratory bend was energized.

Several pieces of equipment for slow extraction were installed. These include a quadrupole and octupole in F sector, a scattering target at F34 and bump magnets to put beam on that target. There is now also a set of vertical bumps in the Transfer Hall.

Extensive computations have been carried out on half-integral resonant extraction. It is now believed that it can be done with one quadrupole (almost all the octupole component needed is present in the main-ring quadrupoles).

#### Main Accelerator

During August, two bending magnets and one quadrupole shorted and were replaced. Many months ago certain of the magnets with plaster insulation were found to have a low-insulation resistance to ground. Eighteen of the magnets were replaced by new magnets and the old magnets were sent to the Meson Laboratory.

All 15 stations of the main-ring rf have been operating without trouble. A main-ring tuner with 9 instead of 10 ferrite cores is being built. It should tune over the needed range, but should be less susceptible to sparking.

#### 30-In. Bubble Chamber

During the accelerator shutdown, the chamber was warmed up to room temperature and the accessible windows and lenses were cleaned. An additional magnet cooling tower was installed to allow chamber operation at 30 kG.

#### 15-Ft Bubble Chamber

The chamber body and vacuum tank of the 15-ft bubble chamber were placed into final location. The pump and purge process for the cool-down of the magnet has begun.



Fig. 1. View of the Central Laboratory construction looking southwest over the main ring. Eleven of the sixteen floors had been poured at this time.

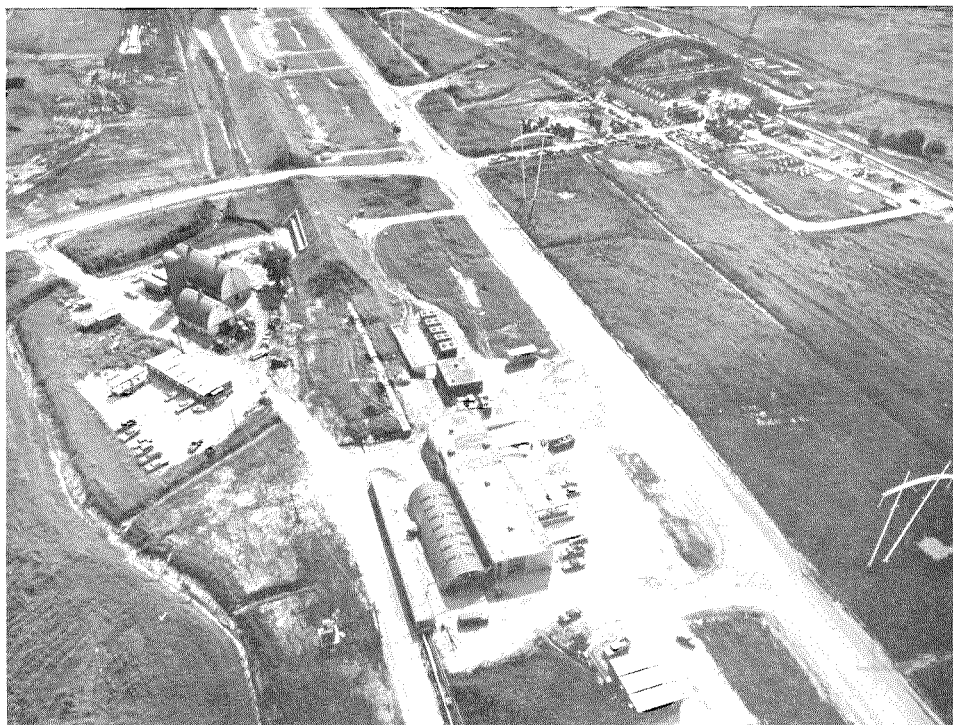


Fig. 2. View of Muon Area looking upstream along Neutrino Laboratory beam line. To the right is the Meson Laboratory experimental area.

APPENDIX I. LIST OF APPROVED EXPERIMENTS

<u>Experiment Number</u>	<u>Institutions</u>	<u>Scientific Spokesman</u>	<u>Subject</u>
1-A	Wisconsin Pennsylvania Harvard	Cline	NAL Neutrino Proposal
2-B	Michigan State Maryland Iowa State ANL, Duke, NAL Notre Dame Toronto, Wisc. Purdue	Smith	Multiparticle Interactions in 30-inch Bubble Chamber and Optical Spark Chamber Hybrid System. 30" b.c.
3	LBL	Eberhard	Search for Magnetic Monopoles at NAL
4-I	Michigan, ANL	Longo	Neutron Total Cross Sections up to 200 GeV
4-II	Michigan, ANL	Longo	Neutron-Proton Diffraction Scattering
6	Michigan, ANL	Krisch	Proton-Proton Elastic Scattering at High Transverse Momentum
7	Michigan, ANL, NAL, Purdue	Meyer	Measurement of $\pi^+p$ and p-p Differential Elastic Scattering Cross Sections from 50 to 170 GeV/c
8	Wisconsin Michigan Rutgers	Pondrom	Experiments in a Neutral Hyperon Beam
12	Ohio State Michigan State Carleton	Reay	A Study of Neutron-Proton Charge-Exchange Scattering
14	Columbia SUNY (Stony Brook)	Franzini	Proposal to Study Inelastic Proton-Proton Collisions in the Diffractive Region
19-A	Wyoming	Tompkins	A Search for Monopole Production
21	Caltech NAL	Barish	Neutrino Physics at High Energies
22	VPI, BNL	Collins	Search for Multigamma Events from Magnetic Monopole Pairs



<u>Experiment Number</u>	<u>Institutions</u>	<u>Scientific Spokesman</u>	<u>Subject</u>
23-A	Washington	Rothberg	Inclusive $\pi p$ and $K p$ Scattering
25-A	UCSB	Caldwell	Measurement of the Total Photo-Absorption Cross Sections
26	Cornell, UCSD, Michigan State	Chen	High Momentum Transfer Inelastic Muon Scattering and Test of Scale Invariance
27-A	Rochester, NAL Northwestern	Rosen	Study of the Coherent Dissociation of Neutrons
28	Wisconsin, CERN	Fry	Neutrino Experiment in 15-ft. Bubble Chamber
31-A	ANL, Carnegie- Mellon	Derrick	Antineutrino Experiment in 15-ft. Bubble Chamber
32	Stanford	Hofstadter	Test and Calibrate a Large NaI TANC Detector
34	Louisiana State, Max-Planck, NASA UC (Berkeley), U of Alabama, U of Arizona	Huggett	Ionization Spectrometer Test and Development
36-A	Rockefeller Rochester, NAL Dubna, USSR	Cool	Small Angle p-p Scattering
37-A	NAL, UCLA	Malamud	30" b.c. - pp at 300 GeV
45-A	NAL, Michigan	Nezrick	Neutrino Experiment in 15-ft. Bubble Chamber.
48	Yale, BNL NAL	Adair	A Measurement of the Intensity and Polarization of Muons Produced Directly by the Interactions of Protons with Nuclei
51	Northeastern, Stanford	von Goeler	Boson Production and Decay
53-A	Columbia, BNL	Baltay	Neutrino Experiment in 15-ft. Bubble Chamber with Neon
61	LBL, Harvard, ANL, Wyoming, Yale, NAL, New Mexico	Chamberlain	Proposal to Measure Polarization in Elastic Scattering at 50, 100 and 150 GeV/c
63	NAL	Walker	Survey of Particle Production in Proton Collisions at NAL

<u>Experiment Number</u>	<u>Institutions</u>	<u>Scientific Spokesman</u>	<u>Subject</u>
67	Rutgers Upsala College U Ill. (Chicago Circle)	Maglic	Search for Baryon Resonances up to 10 GeV Mass Produced in p+p→p+MM
69-A	Yale, NAL	Willis	Elastic Scattering of the Hadron
70	Columbia Rockefeller NAL	Lederman	Study of Lepton Pairs from Proton-Nuclear Interactions
72	BNL, Yale	Leipuner	Quark Search
74	General Elect. NAL	Fleischer	Search for Magnetic Monopoles
75	NAL	Yamanouchi	A Proposal to Search for Fractionally Charged Quarks
76	NAL	Carrigan	Search for Magnetic Monopoles
81	ANL, BNL, Chicago Carnegie-Mellon Purdue SUNY (Buffalo) Los Alamos	Kaufman	Preliminary Survey of 200-GeV Proton Interactions with Complex Nuclei
82	Chicago, SLAC UCSD, NAL	Telegdi	Investigate Regeneration of Neutral K-Mesons at Very High Energies
86-A	U of Washington Orsay	Lubatti	Study Inelastic Diffractive Processes by Observing Coherent Production of Multi-Pion Final States from He Nuclei
87-A	Columbia Hawaii Cornell, Illinois	Lee	Search for Heavy Leptons and Intermediate Bosons from Photon-Nuclei Collisions
90	Cracow	Gierula	Emulsion Experiment
94	Louisiana State	Goza	Emulsion Experiment
95-A	Johns Hopkins NAL	Cox	Proposal for Examination of Wide Angle Gamma Rays at NAL
96	Stanford U of Bari Brown, CERN ANL, Cornell MIT, NAL, Northeastern	Ritson	Focusing Spectrometer Facility

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97	NAL, Yale	Lach	Elastic Scattering of the Hyperons
98	Chicago Harvard Oxford	Mo	Muon-Proton Inelastic Scattering Experiment
100	Princeton Chicago	Piroué	Study Particle Production at High Transfer Momenta
103	U of Tennessee	King	Emulsion Experiment
104	BNL, NAL Rockefeller	Kycia	Measurement of Total Cross Sections on Hydrogen and Deuterium
105	Tata Inst.	Malhotra Ganguli	Emulsion Experiment
108	NAL	Awschalom	A Beam Dump Experiment
110B	Caltech, NAL, UCLA, U of Ill. (Chicago Circle)	Pine	Multiparticle Spectrometer
111	Caltech, LBL, NAL	Tollestrup	Proposal to Study $\pi^- p \rightarrow \pi^0 n$ and $\pi^- p \rightarrow \eta n$ at High Energy
114	SUNY (Buffalo)	Jain	Emulsion Experiment
115	LBL	Stevenson	Search for Long Lived Particles
116	Ottawa, Barcelona, McGill, NAL Toronto, Strasbourg	Hébert	Emulsion Experiment
117	Osaka City U Hiroshima U INS Tokyo U	Kusumoto	Emulsion Experiment
120	Wisconsin Harvard	Cline	Early $\pi^0$ Particle Production Survey with Gas Jet Target
121-A	UC (Davis)	Lander	30" b.c. - $\pi^+ p$ at 100 GeV
125	CERN	Morrison	30" b.c. - $\pi^- p$ at 100 GeV
137	NAL, LBL, UC (Berkeley)	Huson	30" b.c. - $\pi^- p$ at 300 GeV

<u>Experiment Number</u>	<u>Institutions</u>	<u>Scientific Spokesman</u>	<u>Subject</u>
138-I	Rochester Michigan	Ferbel	30" b.c. - pp at 100 GeV
138-II	Michigan Rochester	VanderVelde	30" b.c. - pp at 400 GeV
141-A	ANL, NAL, Iowa State, Michigan State, Maryland	Fields	30" b.c. - pp at 200 GeV
143	BNL	Kalbfleisch	30" b.c. - $\pi^-$ p at 200 GeV
154	MIT, Brown, Ill., IIT Johns Hopkins, Rutgers-Stevens, Yale, NAL, Indiana U of Tenn.-Oak Ridge	Pless	Feasibility Study of Proportional Chamber Hybrid Systems with 30-inch b.c.
155	LBL, Hawaii	Stevenson	Construction and Test of External Muon Identifier for 15-ft. Bubble Chamber
156	U of Tokyo	Niu	Emulsion Experiment
171	U of Washington	Lord	Emulsion Experiment
172	UC (Berkeley) U of Washington	Bingham	Antineutrino Experiment in 15-ft. Bubble Chamber
180	Institute of High Energy Physics (Serpukhov), I.T.E.P. (Moscow), NAL, Michigan	Mukhin	Antineutrino Interactions in 15-ft. Bubble Chamber
183	Lebedev Physical Institute	Tretyakova	Emulsion Experiment